

Culvert and Pipe Phasing



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NCDOT Culvert Phasing Process

- Hydraulics Unit:
 - Culvert Survey Report (CSR)
 - Permit Drawings and Impact Summary
- Hydraulics and Roadside Environmental Units:
 - Develop Culvert Construction Sequence
- Roadside Environmental Unit:
 - Include Culvert Construction Sequence in Erosion Control Plans

Components of Culvert Phasings

- Stilling Basin or Silt Bag
- Impervious Dike
- Temporary Pipe
- Temporary Channel Change

Stilling Basin Design

- Volume (ft³) = Width of Stream Channel (ft.) x (Length of Culvert (ft.) + 20 ft. (10 ft. on Each Side)) x Depth of Water in Stream (ft.)
- Typically used for Volumes > 100 CY (2700 ft³)
- Freeboard = 6 inches (Minimum)
- Design Permeable Stone Drain to Dewater at a Slow Rate
- Add Volume to Required Volume of Sediment Basins

NOTES

INSTALL COIR FIBER BAFFLES IN ACCORDANCE WITH ROADWAY STANDARD DRAWING NO. 1640.01.

INSTALL THE TOP OF THE COIR FIBER BAFFLE A MINIMUM OF 6" LOWER THAN THE TOP OF THE STILLING BASIN BERMS.

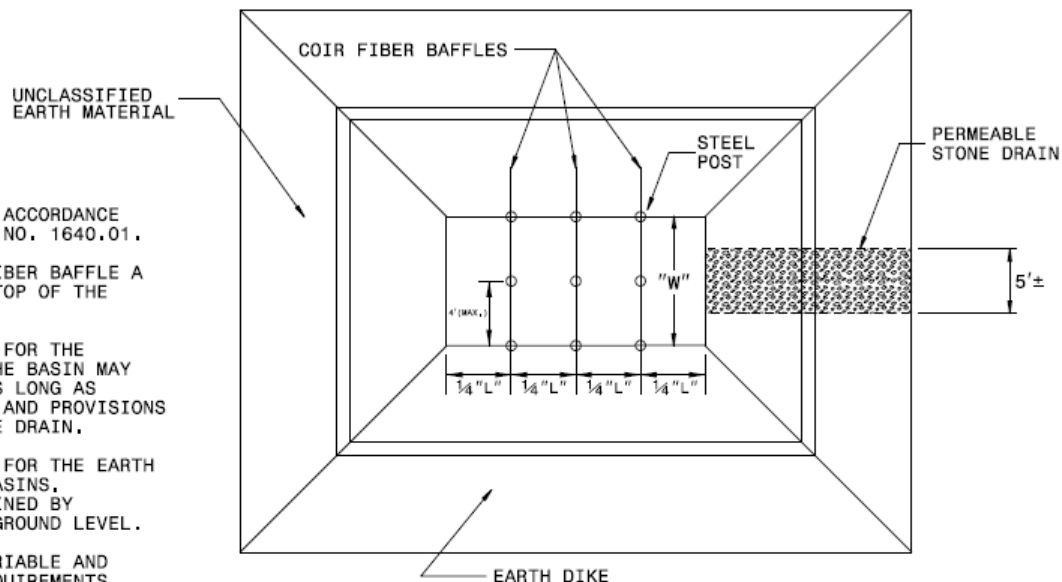
USE THE TYPICAL SECTION SHOWN FOR THE STILLING BASIN AS A GUIDE. THE BASIN MAY HAVE ANY TYPE CONFIGURATION AS LONG AS SUFFICIENT VOLUME IS PROVIDED AND PROVISIONS ARE MADE FOR A PERMEABLE STONE DRAIN.

DO NOT EXCEED 5 FT. IN HEIGHT FOR THE EARTH DIKES REQUIRED FOR STILLING BASINS. ADDITIONAL DEPTHS MAY BE ATTAINED BY EXCAVATING BELOW THE NATURAL GROUND LEVEL.

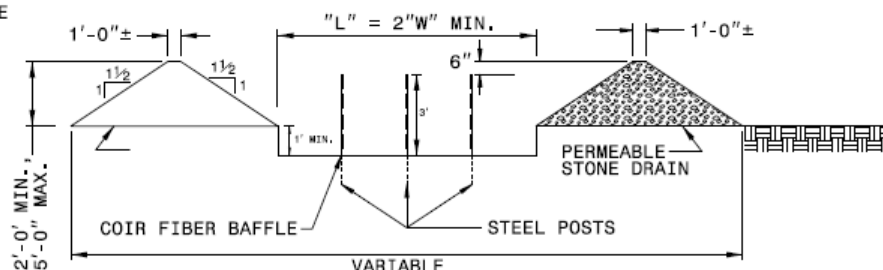
THE STILLING BASIN SIZE IS VARIABLE AND DEPENDENT ON SPECIFIC SITE REQUIREMENTS AS WELL AS PROPOSED CONSTRUCTION OPERATIONS.

SUBMIT THE SIZE, LOCATION AND PERMEABLE STONE DRAIN MATERIAL FOR APPROVAL PRIOR TO CONSTRUCTION.

PUMP THE EFFLUENT INTO THE STILLING BASIN TO A MAXIMUM DEPTH OF 3 FEET.



PLAN VIEW



TYPICAL SECTION VIEW

Stilling Basin Volume Design

- Formula for Stilling Basin Volume:

$$\text{Volume} = \frac{d}{3} \left[W_{\text{top}} L_{\text{top}} + W_{\text{base}} L_{\text{base}} + \left(\frac{W_{\text{top}} L_{\text{base}} + W_{\text{base}} L_{\text{top}}}{2} \right) \right] + W_{\text{base}} L_{\text{base}} \times 1 \text{ ft.}$$

- $d = 3 - 5 \text{ ft.}$
- Side Slope = 1.5:1

Stilling & Sediment Basin Design

- Example of Stilling Basin as Sediment Basin:
 - Required Volume for Sediment Basin = 1800 ft^3
 - Required Volume for Stilling Basin = 1500 ft^3
 - Provided Volume of Sediment Basin = 2820 ft^3
- Additional Volume Needed for Sediment Basin =

$$1800 + 1500 - 2820 = \underline{480 \text{ ft}^3}$$

Stilling Basin Placement

- Inside Perimeter EC Devices
- Level Ground
- Locate to Avoid Pumping Across Stream
- Avoid Placing in Locations of Sediment Basins

Stilling Basin Construction

- Construct Above Ground with Length:Width Ratio of 2:1
- Install 3 Coir Fiber Baffles
- Excavate 1 ft. Below Ground for Permanent Pool
- Stabilize Interior and Exterior Slopes
- Use Small Grade Stone (NCDOT Class A & B, No. 57)

Stilling Basin



Stilling Basin with Geotextile Liner



Stilling Basin with Flashboard Riser

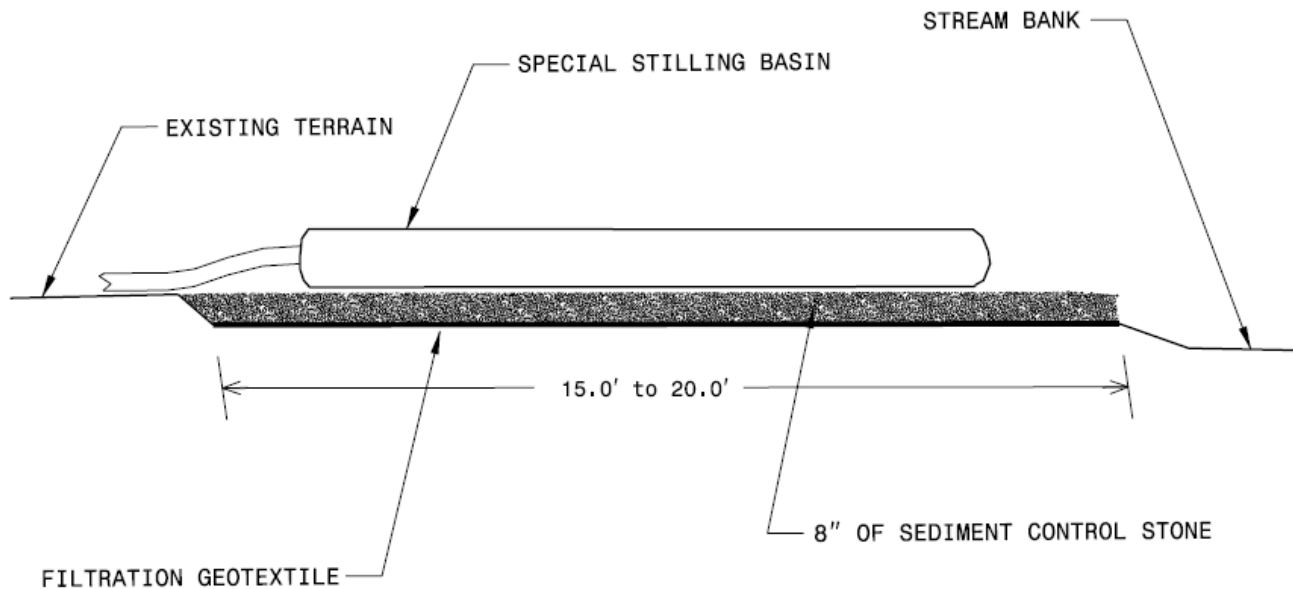


Flashboard Riser



Silt Bag Design & Placement

- Maximum Pumping Rate of 80 gal/min/sf
- Typically, Volumes less than 100 CY (2700 ft³)
- Place Inside Perimeter EC Devices
- Place on Level Ground
- Locate to Avoid Pumping Across Stream



NOTES

USE NO. 5 OR NO. 57 STONE FOR SEDIMENT
CONTROL STONE.

PROVIDE STABILIZED OUTLET TO STREAM BANK.
WOOD PALLETS MAY BE USED IN LIEU OF STONE
AND GEOTEXTILE AS DIRECTED. A SUFFICIENT NUMBER
OF PALLETS MUST BE PROVIDED TO ELEVATE THE ENTIRE
SPECIAL STILLING BASIN ABOVE NATURAL GROUND.

NOT TO SCALE

Silt Bag Installation

- Install Geotextile (NCDOT Type 2) under Bag
- Place No. 57 Stone or Wood Pallets under Bag
- Always Keep Extra Bag(s) Onsite!
- Flocculants and Polymers will Clog Pores of Bag

Silt Bag



Impervious Dike

- Dike Types:
 - Sand Bags
 - Sheet Piling
 - Stone with Polypropylene
- Used in Stream Channel at Upstream and Downstream of Site
- Used to Anchor Temporary Pipes
- Used to Create Side of Temporary Channel

Sand Bags



Sheet Piles



Stone with Geotextile



Temporary Pipe Design & Construction

- Design to Average Daily Flow (ADF)
- Common Sizes: 15", 18" and 24"
- Anchor Ends with Impervious Dikes
- Used Primarily for Culvert Extensions

Temporary Pipe



Temporary Channel Design

- Design to Carry Average Daily Flow (ADF)
- Use Maximum of 2:1 Side Slopes
- Design as Base Ditch
- Don't Design in Areas of Existing Fill Slopes!

Temporary Channel Construction

- Line with Geotextile (NCDOT Type 4)
- Protect Top of Channel with:
 - Berms
 - Silt Fence
 - Impervious Dike

Berm at Top of Temporary Diversion



Silt Fence with Temporary Diversion



Types of Culvert Phasings

- Pump and Dike
- Dike Only
- Dike and Pipe
- Dike and Temporary Channel

BEST MANAGEMENT PRACTICES FOR CONSTRUCTION AND MAINTENANCE ACTIVITIES

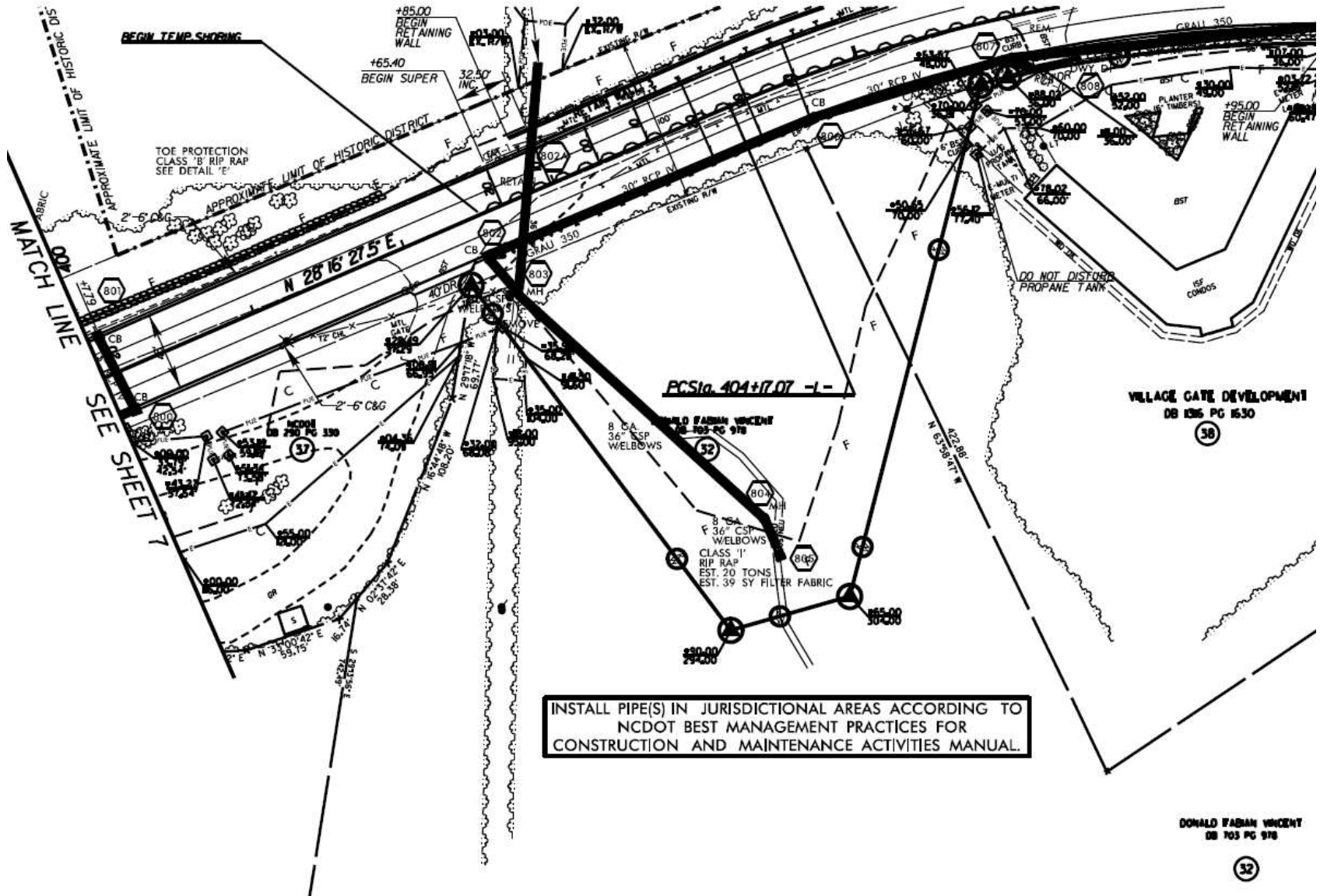
*NORTH CAROLINA DEPARTMENT
OF TRANSPORTATION*



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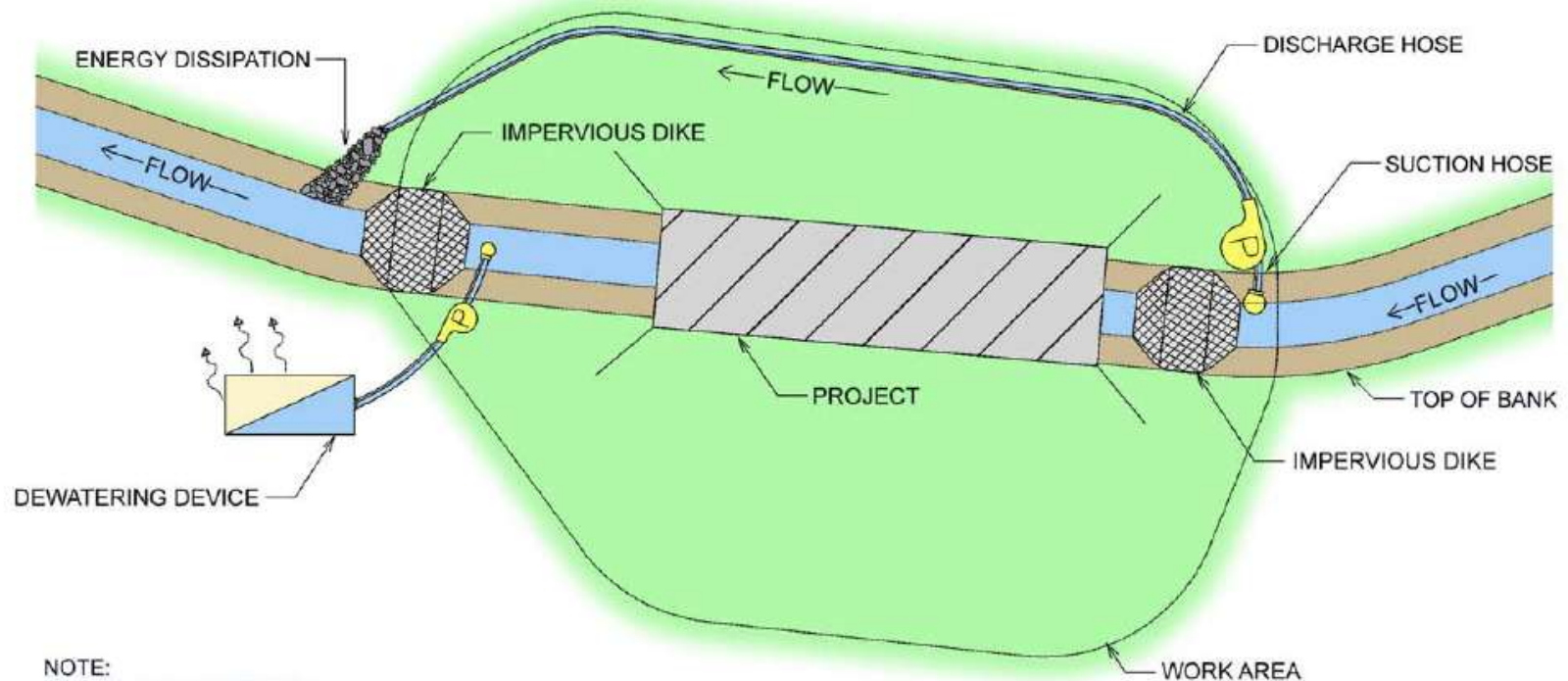
Phasing Per BMP Manual Note



Pump and Dike

- Short Duration Process (Max. 5 days!)
- Use for Pipe Installation
- Include Pump-Around Detail in the Plans
- Reference BMP Manual with Note

MANAGING THE WATERCOURSE: BYPASS PUMPING

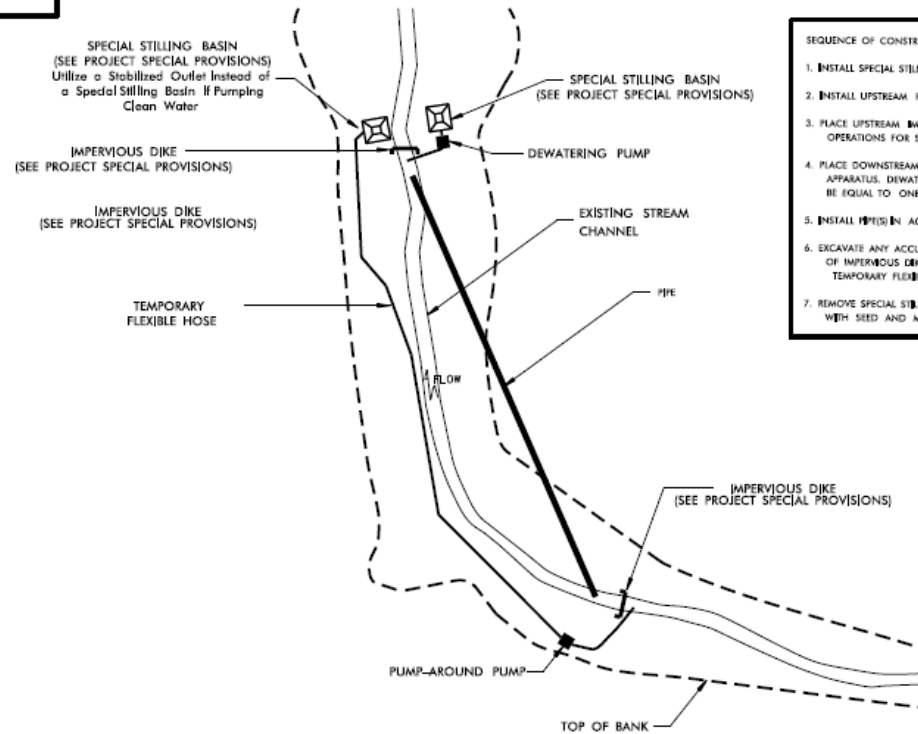


EXAMPLE OF PUMP-AROUND OPERATION

PROJECT REFERENCE NO. X-XXXX	SHEET NO. EC-DE
RDW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

NOTES:

- 1) All excavation shall be performed in only dry or isolated areas of the work zone.
- 2) Impervious dikes are to be used to isolate work from stream flow when necessary.
- 3) Maintenance of stream flow operations shall be incidental to the work. This includes polyethylene sheeting, diversion pipes, pumps and hoses.
- 4) Pumps and hoses shall be of sufficient size to dewater the work area.



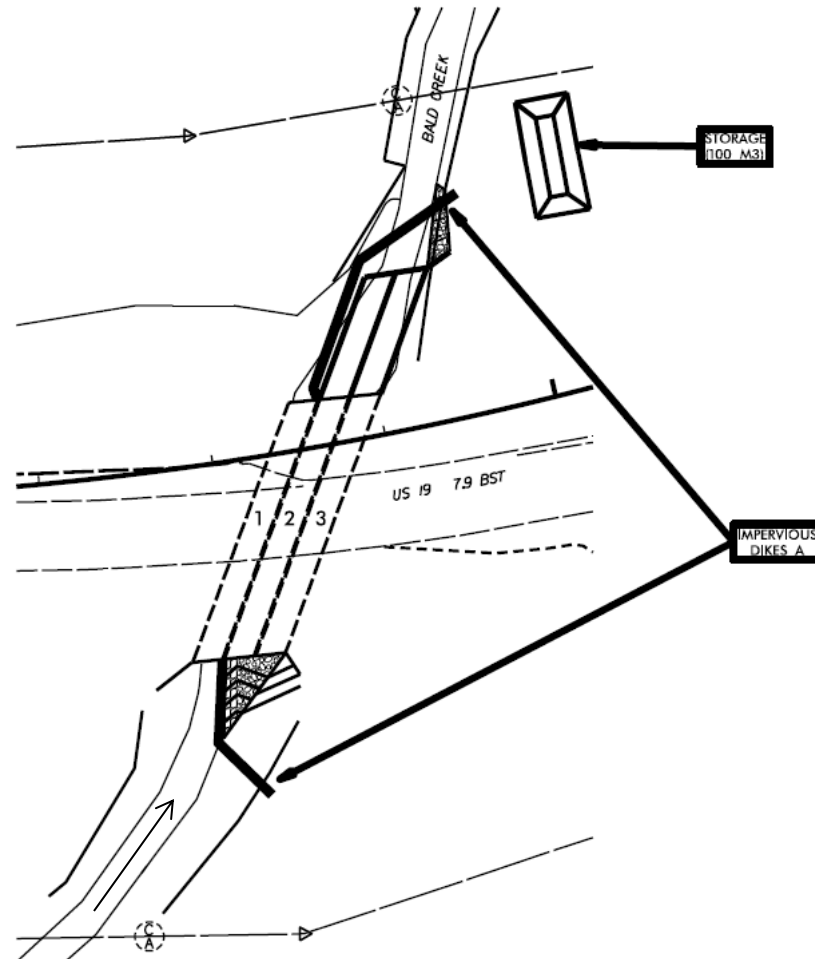
SEQUENCE OF CONSTRUCTION FOR TYPICAL WORK AREA

1. INSTALL SPECIAL STILLING BASIN(S).
2. INSTALL UPSTREAM PUMP AND TEMPORARY FLEXIBLE HOSE.
3. PLACE UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
4. PLACE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS. DEWATER ENTRAPPED AREA. AREA TO BE DEWATERED SHALL BE EQUAL TO ONE DAY'S WORK.
5. INSTALL PIPE(S) IN ACCORDANCE WITH THE PLANS.
6. EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF IMPERVIOUS DIKES. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE (DOWNSTREAM IMPERVIOUS DIKES FIRST).
7. REMOVE SPECIAL STILLING BASIN(S) AND BACKFILL. STABILIZE DISTURBED AREA WITH SEED AND MULCH.

Impervious Dike Phasing

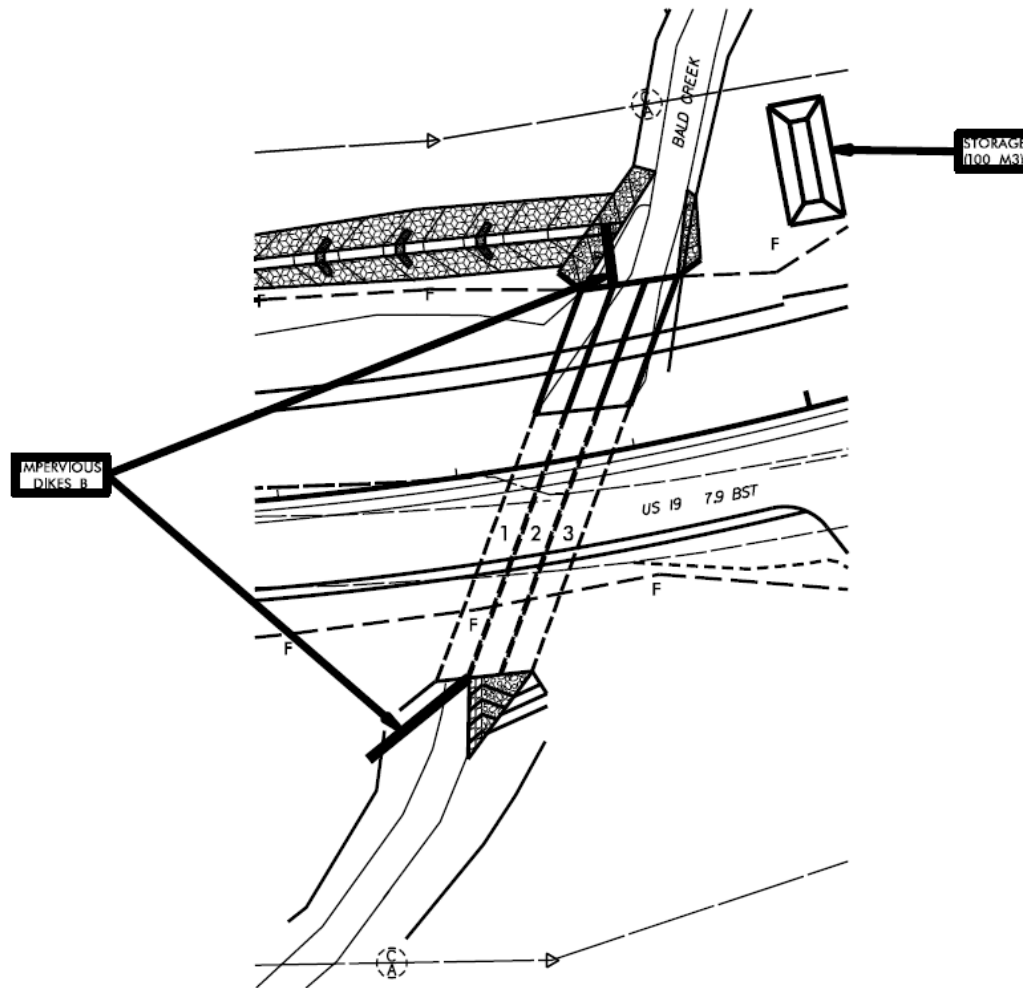
- Short Duration Process
- Use for Pipe Installation/Culvert Extension
- Include Dewatering Details in Phasing
- Do not Block Channel with Dike!

Culvert Extension with Dike



1. CONSTRUCT STILLING BASIN (100 M3).
2. CONSTRUCT IMPERVIOUS DIKES A, DIVERTING FLOW THROUGH BARREL 1.
3. REMOVE EXISTING HEADWALL AND CONSTRUCT EXTENSIONS FOR BARRELS 2 AND 3.
4. CONSTRUCT PORTION OF PROPOSED HEADWALL AND PORTION OF INLET/OUTLET CHANNEL IMPROVEMENTS.
5. REMOVE IMPERVIOUS DIKES A.

Culvert Extension with Dike

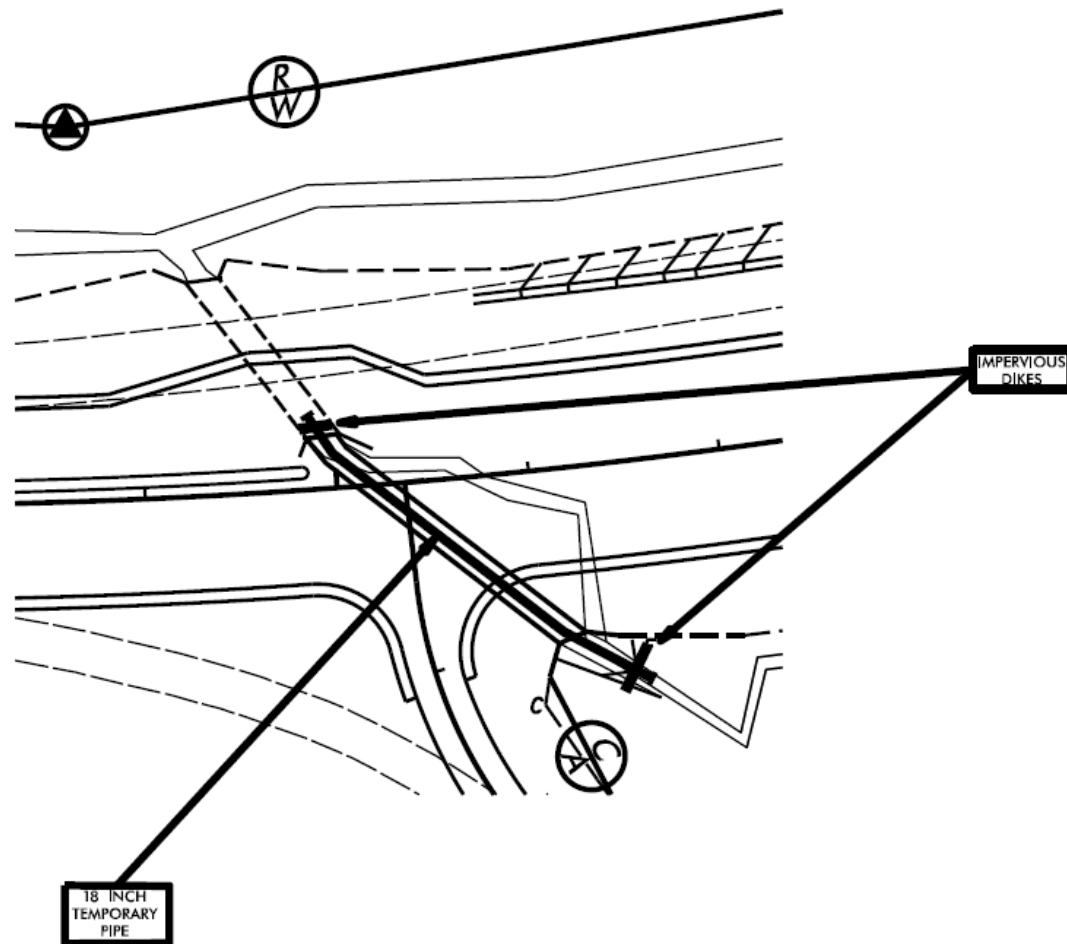


6. CONSTRUCT IMPERVIOUS DIKES B, DIVERTING FLOW THROUGH BARRELS 2 AND 3.
7. CONSTRUCT EXTENSION FOR BARREL 1, REMAINDER OF PROPOSED HEADWALL, AND REMAINDER OF INLET/OUTLET CHANNEL IMPROVEMENTS.
8. REMOVE IMPERVIOUS DIKES B AND STILLING BASIN.
9. COMPLETE ROADWAY.

Temporary Pipe Phasing

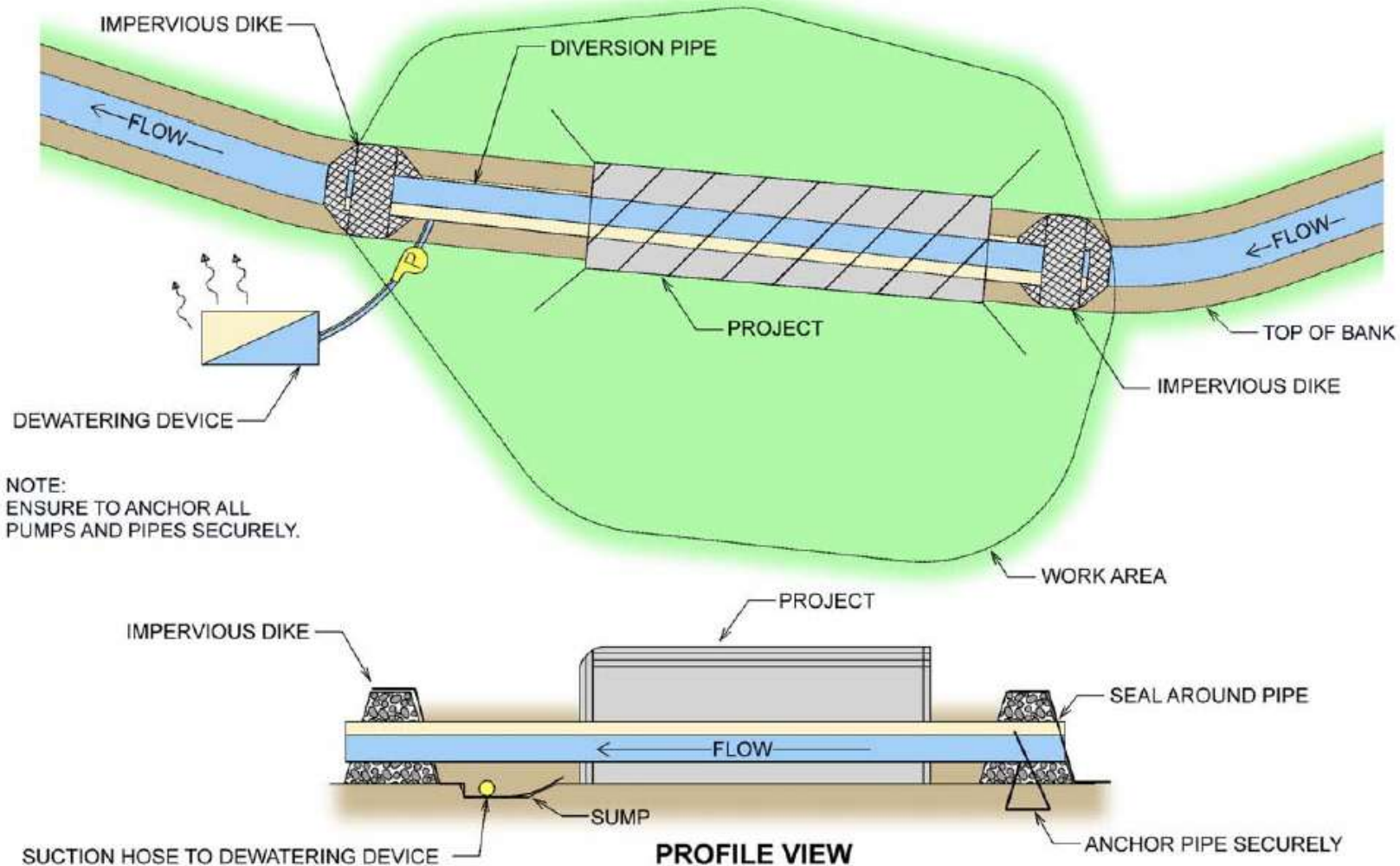
- Use for Pipe Installation/Culvert Extension
- Can be Utilized for New Culverts
- Include Dewatering Details in Phasing
- Anchor Pipe(s) with Impervious Dike

Phasing with Pipe and Dike

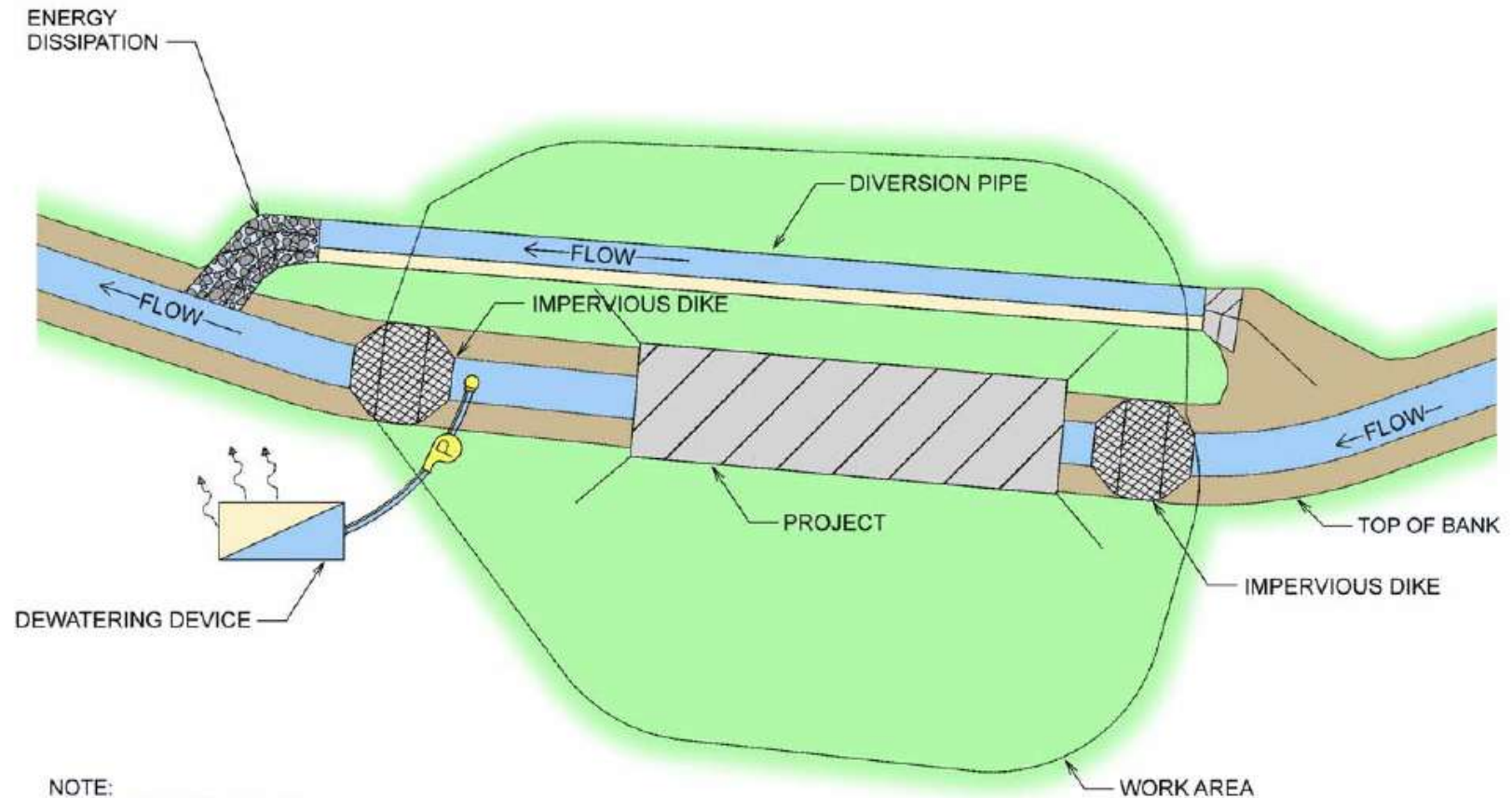


1. UTILIZE SPECIAL STILLING BASIN(S) DURING CULVERT CONSTRUCTION AS NEEDED.
2. CONSTRUCT IMPERVIOUS DIKES AND INSTALL 18 INCH TEMPORARY PIPE, DIVERTING FLOW THROUGH THE TEMPORARY PIPE.
3. CONSTRUCT CULVERT EXTENSION.
4. REMOVE IMPERVIOUS DIKES AND TEMPORARY PIPE.
5. CONSTRUCT ANY NECESSARY CHANNEL IMPROVEMENTS.
6. COMPLETE ROADWAY.

MANAGING THE WATERCOURSE: SUSPENDED BYPASS PIPE



MANAGING THE WATERCOURSE: PIPED DIVERSION

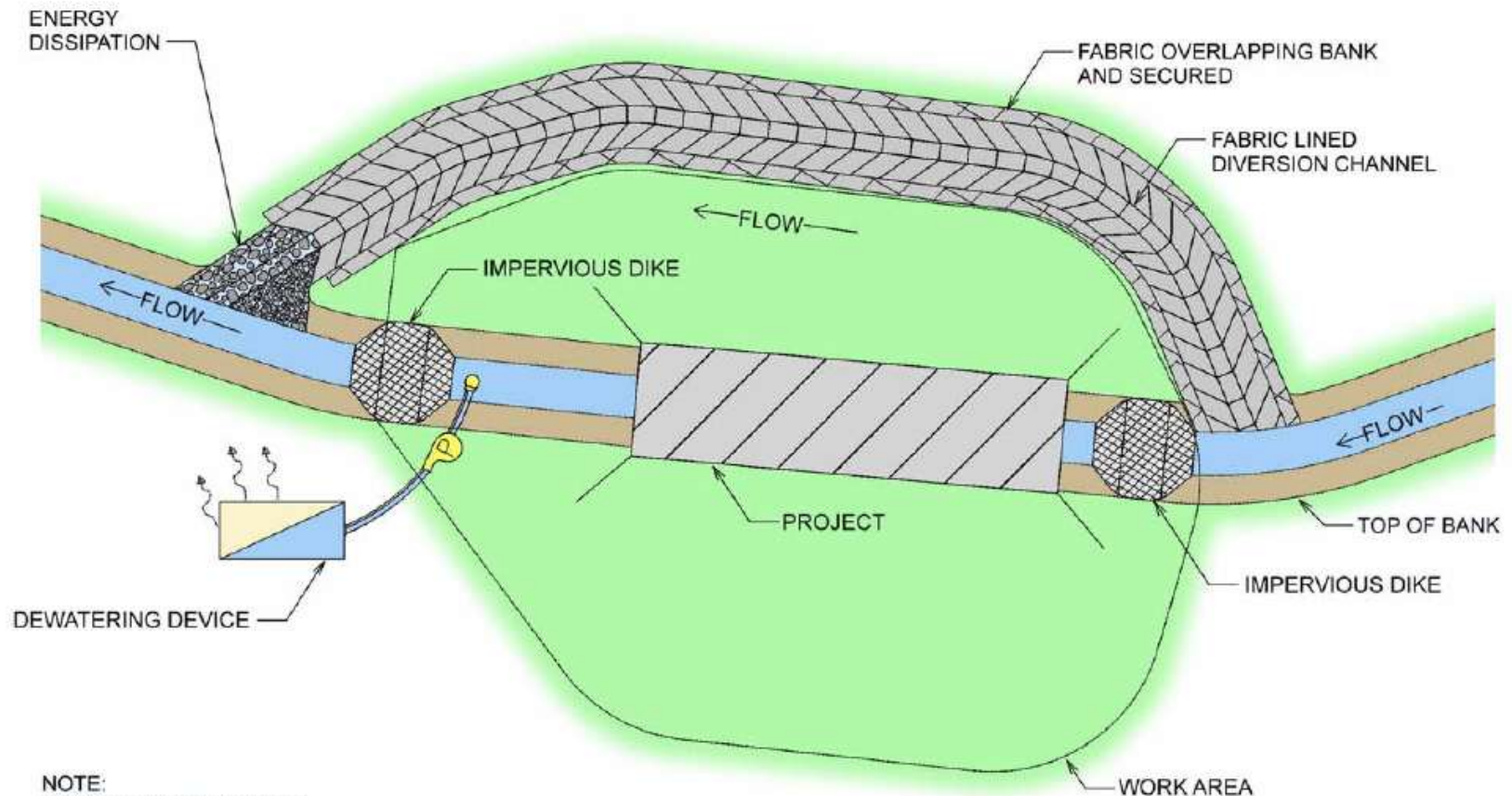


NOTE:
ENSURE TO ANCHOR ALL
PUMPS AND PIPES SECURELY.

Phasing with Temporary Channel

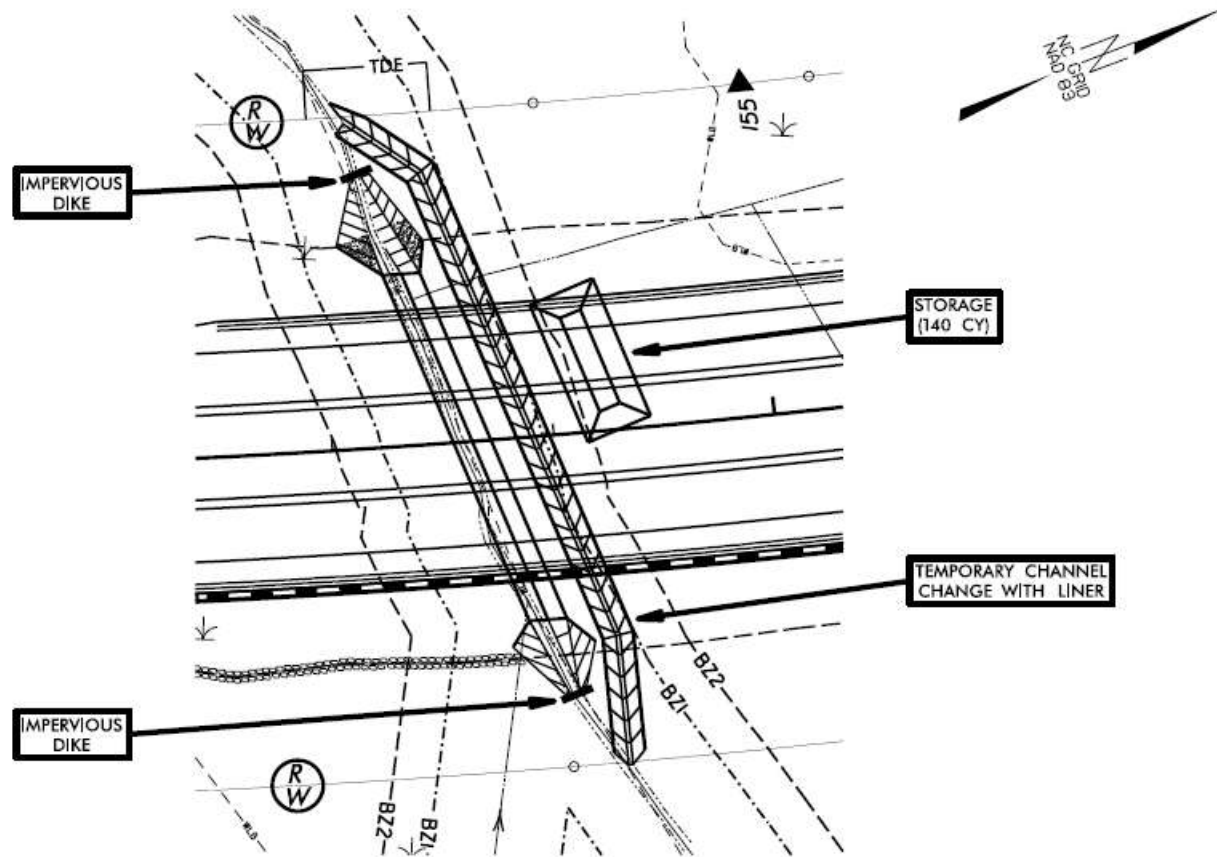
- Include Permit Impacts for Channel Tie-Ins
- Design/Build with Room to Install Wing Walls
- Include Channel Dimensions:
 - Base Width
 - Channel Depth
 - Side Slope Info

MANAGING THE WATERCOURSE: FABRIC LINED DIVERSION CHANNEL



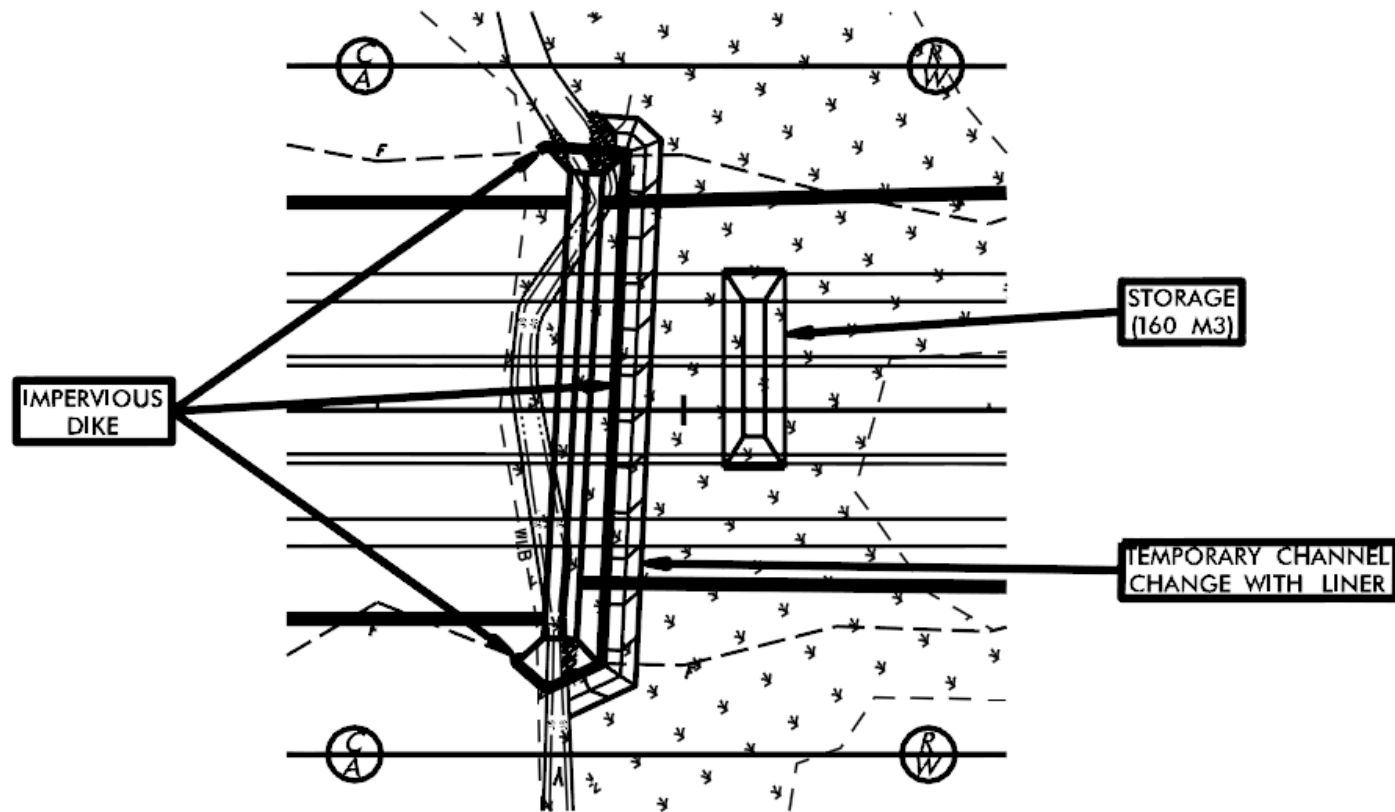
NOTE:
ENSURE TO ANCHOR ALL
PUMPS AND PIPES SECURELY.

Phasing with Temporary Channel



1. CONSTRUCT STILLING BASIN (140 CY).
2. CONSTRUCT TEMPORARY CHANNEL CHANGE WITH LINER (2 FT. BASE, 3 FT. DEEP, 2:1 SIDE SLOPES).
3. CONSTRUCT IMPERVIOUS DIKES, DIVERTING FLOW THROUGH TEMPORARY CHANNEL CHANGE.
4. CONSTRUCT PROPOSED CULVERT AND INLET/OUTLET CHANNEL IMPROVEMENTS.
5. REMOVE IMPERVIOUS DIKES AND TEMPORARY CHANNEL CHANGE, DIVERTING FLOW THROUGH PROPOSED CULVERT.
6. REMOVE STILLING BASIN, AND COMPLETE ROADWAY.

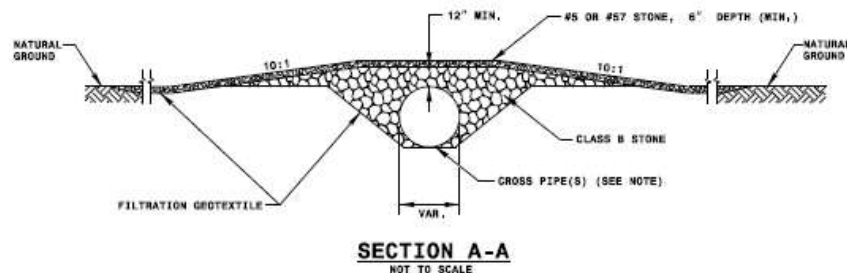
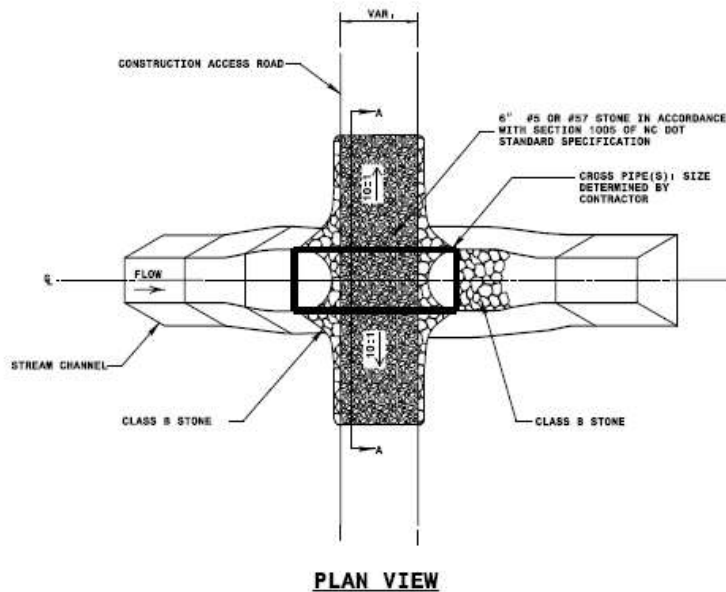
Impervious Dike with Channel



1. CONSTRUCT STILLING BASIN (160 M3).
2. CONSTRUCT IMPERVIOUS DIKE AND TEMPORARY CHANNEL CHANGE WITH LINER (2.5M BASE, 1M DEEP, 2:1 SIDE SLOPE), DIVERTING FLOW.
3. CONSTRUCT PROPOSED CULVERT.
4. REMOVE IMPERVIOUS DIKE AND TEMPORARY CHANNEL CHANGE, ALLOWING FLOW THROUGH CULVERT.
5. COMPLETE ANY NECESSARY INLET/OUTLET CHANNEL IMPROVEMENTS.
6. REMOVE STILLING BASIN.
7. COMPLETE ROADWAY.

Temporary Stream Crossing Design & Construction

- Design to Carry 2-yr Storm
- More than One Pipe can be Used
- Install Geotextile (Type 2) under Pipe(s) and Stone
- Use Class B and No. 57 Stone



NOTES

PIPE(S) FOR TEMPORARY STREAM CROSSING SHALL BE DESIGNED TO PASS THE PEAK OR BANKFULL FLOW, WHICHEVER IS LESS, FROM A 2-YEAR PEAK STORM, WITHOUT OVER TOPPING.

Stream Crossing at Diversion



Stabilization for Culverts

- Seed and Mat in Timely Manner
- Mat Slopes (Straw, Excelsior, Permanent)
- Place Coir Fiber Mat on Stream Banks at Inlet
- Protect Seeded Area with Temporary EC Devices

Stabilized Slopes



Enhancements for Stilling Basins

- Coir Fiber Baffles
- Pumping Water from Top of Basin Water
- Permanent Pool
- Flocculants

Flocculant Incorporation



Flocculant Incorporation



Considerations for Culvert Phasing

- Develop in Conjunction with EC Plan
- Culvert Phasing a Recommendation and Dependent on:
 - Contractor
 - Site Conditions
- Include Details in Construction Sequence

NCDOT Web Site Links

- REU Soil & Water Engineering Section

http://www.ncdot.org/doh/operations/dp_chief_eng/roadside/soil_water/

- NCDOT BMP Manual

<http://www.ncdot.gov/doh/forms/files/BMPMANUAL.pdf>

- NCDOT Hydraulics Unit

<http://www.ncdot.org/doh/preconstruct/highway/hydro/>

Questions?

